

3. Contributions to the Anatomy of the Kagu (*Rhinochetus jubatus*). By FRANK E. BEDDARD, M.A., Prosector to the Society.

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The structure of the Kagu, so far as it is at present known, has shown it to be a bird which stands in a central position with respect to several groups. It cannot be included in any of the existing families without doing violence to some one of its structural characteristics.

All that is known of the anatomy of this bird refers to external features, to the skeleton, to the viscera, and to a few of its muscles; and opinions as to its affinities, based more or less upon these characters, are varied. There can be no doubt, however, that it stands somewhere in the Ardeogralline group.

With a view to assist in the more accurate placing of *Rhinochetus*, I offer here an account of some of the principal muscles which I have dissected in a specimen that died in the Society's Gardens a few years since.

The Kagu was described so recently as 1860 by MM. Des Murs and Verreaux [1]; but the first account of its anatomy is contained in a short paper by Prof. Parker [6] on certain points in the Osteology, expanded later [7] into an elaborate description of the entire skeleton. After the publication of these two papers, Dr. Murie contributed to the 'Transactions' of this Society a valuable account [8] of the external characters and of the alimentary viscera, comparing the bird in all these matters with *Eurypyga* and with the Boatbill (*Cancroma*). More recently Prof. Garrod has remarked upon the carotids and upon the muscles of the thigh [19]. The disposition of the intestinal coils has been described by Dr. Gadow [16], while Mr. Seebohm [9] has directed attention to a few points in the osteology.

I am not acquainted with any other papers that deal with the structure of *Rhinochetus*.

The following is a list of the papers which I have consulted in putting together the present notes:—

- (1) DES MURS and J. VERREAUX.—Revue et Mag. de Zool. t. xiii. (1860) p. 441.
- (2) POUGET.—Note sur le Kagou. Bull. Sociét. Acclim. (3) t. ii. p. 162.<sup>1</sup>
- (3) BARTLETT, A. D.—Note on the Habits and Affinities of the Kagu (*Rhinochetus jubatus*). P. Z. S. 1862, p. 218.

<sup>1</sup> In this paper the author illustrates, by some good woodcuts, the attitudes of the bird—particularly the elevation of the crest, which I have myself frequently observed at the Gardens. He also points out that the name was written by the describers "*Rhynochetos*," and that therefore, in his opinion, their spelling should be used.

- (4) BARTLETT, A. D.—Notes on the Breeding of several Species of Birds in the Society's Gardens during the year 1865. P. Z. S. 1866, p. 76.
- (5) BARTLETT, A. D.—Notes on the Breeding of several Species of Birds in the Society's Gardens during the year 1867. P. Z. S. 1868, p. 114.
- (6) PARKER, W. K.—On the Osteology of the Kagu (*Rhinocetus jubatus*). P. Z. S. 1864, p. 70.
- (7) PARKER, W. K.—On the Osteology of the Kagu (*Rhinocetus jubatus*). Tr. Z. S. vol. vi. p. 501.
- (8) MURIE, J.—On the Dermal and Visceral Structures of the Kagu, Sun-Bittern, and Boatbill. Tr. Z. S. vol. vii. p. 465.
- (9) SEEBOHM, H.—An Attempt to Diagnose the Suborders of the Great Gallino-Gralline Group of Birds by the aid of Osteological Characters alone. Ibis, 1888, p. 415.
- (10) BENNETT, G.—Letter from. P. Z. S. 1862, p. 84.
- (11) BENNETT, G.—Letter from. P. Z. S. 1862, p. 107.
- (12) BENNETT, G.—Notes on the Kagu. P. Z. S. 1863, p. 385.
- (13) BEDDARD, F. E.—On the Structure of *Psophia* and on its Relations to other Birds. P. Z. S. 1890, p. 329.
- (14) BEDDARD, F. E.—A Contribution to the Anatomy of *Scopus umbretta*. P. Z. S. 1884, p. 543.
- (15) FÜRBRINGER, M.—Untersuchungen zur Morphologie und Systematik der Vögel. Amsterdam, 1888.
- (16) GADOW, H.—Aves, in Bronn's 'Klassen und Ordnungen des Thierreichs,' Bd. vi.
- (17) NEWTON, A.—Article "Ornithology" in 11th ed. of 'Encyclopædia Britannica.'
- (18) SCLATER, P. L.—Remarks on the present State of the Systema Avium. Ibis, 1880, p. 340 *et seq.* & p. 399 *et seq.*
- (19) GARROD, A. H.—Collected Papers. Edited by W. A. Forbes. London, 1861.
- (20) SHUFELDT, R. W.—The Myology of the Raven. London, 1890.
- (21) WELDON, W. F. R.—On some Points in the Anatomy of *Phœnicopturus* and its allies. P. Z. S. 1883, p. 638.
- (22) FORBES, W. A.—Collected Papers. Edited by F. E. Beddard. London, 1885.

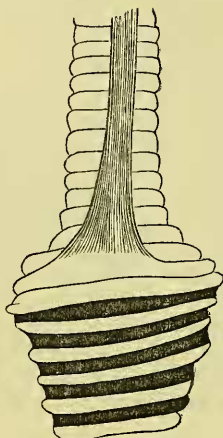
### *Syrinx.*

The syrinx of *Rhinocetus* is displayed in the accompanying drawing (fig. 1, p. 11). It will be seen that it is not specially distinctive, and that it does not afford much help in deciding upon the affinities of the bird. The lateral muscles spread out into a fan-like insertion on to the third bronchial semiring; the 2nd, 3rd, and 4th bronchial semirings are thicker than any of the preceding or succeeding rings. The bronchidesmus is incomplete. The syrinx is not unlike that of the Ardeidæ, but is also like that of *Ocydromus* and other Rail-like birds.

*Myology.*

The account of the muscular anatomy, which I am able here to offer to the Society, is very far from being complete. My material (a single specimen which had been already partially dissected by one of my predecessors) was not sufficient to permit of an exhaustive description of the muscles. However, in the present state of our knowledge of Avian myology, there are comparatively few muscles which have been shown to have any classificatory importance; concerning most of these I have something to say.

Fig. 1.

Syrinx of *Rhinocetus*, from the side.

At present all that is known about the muscles of *Rhinocetus* is contained in the late Prof. Garrod's well-known paper upon bird classification [19], and is therefore restricted to a statement that the ambiens, femorocaudal, semitendinosus, and accessory semitendinosus muscles are present.

I. MUSCLES OF THE FORE LIMB.—(1) The *Tensor patagii longus* and the *tensor patagii brevis* both have a fleshy origin from the clavicle; close to the commencement of their long tendons of insertion the two muscles are firmly attached to each other by fibrous tissue; near to this point, as is commonly the case, a tendinous slip from the humerus joins the muscles; and there is also a tendinous slip arising from the great pectoral muscle.

The tendon of insertion of the *tensor patagii longus* presents no noteworthy particulars; the tendon of insertion of the *tensor brevis* is extremely complicated; these tendons are connected with a thin aponeurotic fascia covering some of the extensor muscles of the forearm, and the two inner of the three branches by which the tendon

is attached to the tendon of the *extensor metacarpi radialis longus* are prolonged some way beyond that tendon.

There is no tendinous slip uniting the distal end of the tendon of the *tensor patagii brevis* with the tendon of the *tensor patagii longus*.

Neither was there any trace, that I could discover, of a *Biceps slip* running from the *Biceps* muscle to the tendon of the *tensor patagii longus*.

The arrangement of these muscles and tendons is not characteristically like that of any of the allied groups; most of the Geranomorphæ of Prof. Huxley have the *Biceps slip*, which is, however, absent in *Cariamidæ* and in the *Bustards*. I may take this opportunity of mentioning that in the *Golden Plover* (Forbes MS.) the *Biceps slip* is tendinous, not muscular. *Eurypyga helias*, generally regarded as a near ally of *Rhinochetus*, has a large *Biceps slip* [15]; I can confirm this by my own dissections.

On the other hand, the *Herodiones* have no *Biceps slip*, but the arrangement of the tendons of the *tensores patagii* differs from that of *Rhinochetus* in the presence of a recurrent slip running from the insertion of the *tensor patagii brevis* to the middle of the *tensor patagii longus* tendon. The only birds known to me with which *Rhinochetus* can be usefully compared, which have not this recurrent tendon, are the *Rails*, *Eurypyga*, and *Cariama*.

(2) The *Rhomboideus superficialis* is a large fleshy muscle with a tendinous origin for the greater part; it is inserted into the entire length of the scapula, with the exception only of a very small portion at the free extremity, also into the clavicle: this muscle is much thicker anteriorly than posteriorly, but thinnest of all in the middle; posteriorly its origin is fleshy, but at the end of the second third of the muscle it begins to have a tendinous origin which increases in breadth anteriorly.

(3) The *Rhomboideus profundus* is as usual of much less extent than the *rhomboideus superficialis*; its origin is tendinous throughout; it is attached along the scapula for about half the length of the bone; the fibres of the muscle run at an acute angle with those of the *rhomboideus superficialis*; at the extremity of the scapula this muscle is not covered by the *superficialis*.

(4) The *Latissimus dorsi*, as usual, is double; the anterior section of the muscle (see fig. 2, *L.d.* 1, p. 13) arises from the spine of the last free dorsal vertebra and from the spines of a portion of the succeeding fused mass of vertebræ. It is inserted by a broad fleshy insertion on to the humerus between the *biceps* and *deltoid*.

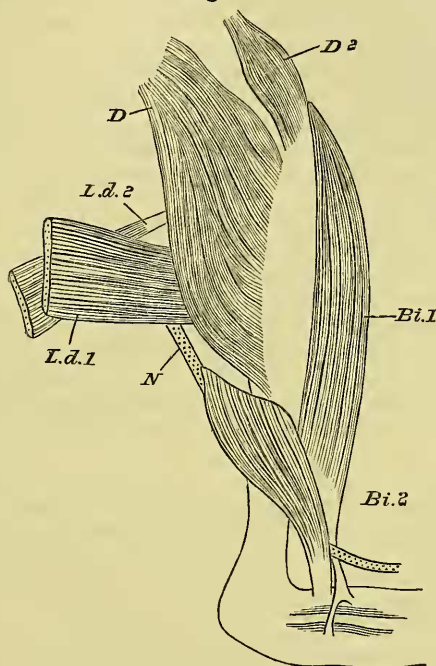
The posterior part of the *latissimus dorsi* (*L.d.* 2) is not continuous at its origin with the anterior; it arises from the spines of the fused set of dorsal vertebræ, from the spine of the following vertebra, and also from the edge of the ilium. Its fibres rapidly converge to a tendon which crosses the anterior muscle, running below it, and is inserted on to the humerus above the insertion of the anterior *latissimus dorsi* in common with the accessory tendon of the *anconæus longus*.

(5) The *Deltoid* (fig. 2, *D*, *D*<sup>2</sup>, p. 13) is largely developed and

extends about halfway down the humerus, being therefore larger than in the Herons.

(6) The *Anconæus longus* arises from the neck of the scapula by two distinct origins; one is chiefly fleshy, the other is formed by a short stout tendon and is placed nearer to the free end of the scapula than the other. The muscle is, as has been already mentioned, attached to the humerus by a flat tendon which joins that of the posterior latissimus dorsi. The presence or absence of this tendon

Fig. 2.



Muscles of fore limb of *Rhinocetus*.

*D*, *D*<sup>2</sup>, deltoid; *L.d.* 1, *L.d.* 2, latissimi dorsi; *Bi.* 1, biceps; *Bi.* 2, accessory biceps; *N*, nerve.

is often a fact worth noting for classificatory purposes. Most of the allies of *Rhinocetus*, however, are provided with the tendon in question.

(7) The *Biceps* (fig. 2, *Bi.* 1) arises by two distinct heads, as is so generally the case among birds, by a long slender tendinous head from the coracoid and by a broad fleshy origin from the humerus. Just at its insertion the tendon of the muscle divides into two, one being attached to the radius, the other to the ulna.



(8) In addition to the biceps there was a very remarkable muscle present which I have once before observed; unfortunately I have no note of the bird in which it occurred. This muscle is a kind of *accessory biceps*: it arises from the humerus just below the insertion of the deltoid by a tendinous sheet; in the specimen before me, as shown in the drawing (fig. 2, *Bi.2*, p. 13), the muscle was prolonged forwards, running parallel to the fibres of the deltoid and closely embracing the nerve (*N.*) which supplies this part of the wing; the appearances presented were suggestive of an origin from the sheath of the nerve, which of course seems hardly likely. The muscle gradually diminishes in width as it passes down towards the radius and becomes tendinous, but I did not succeed in making out the exact mode of its insertion.

Dr. Gadow mentions no muscle that can be compared with this.

(9) The *Expansor secundariorum* is present; the tendon is of considerable size; I did not observe its mode of insertion. The *Expansor secundariorum* seems to be present in all the Cranes and Plovers and in most Herodiones; its absence, however, in *Cancroma* and *Egretta* shows that it is on the wane in that group.

(10) The *Triceps* has the usual two heads situated close together just beneath the head of the humerus.

(11) The *Pectoralis primus* has a large insertion area on the crista superior of the humerus; there is no second insertion such as is met with among many birds.

(12) The *Pectoralis secundus* is well developed, and its origin extends back to nearly the end of the narrow sternum.

(13) The *Coraco-brachialis longus* arises from the coracoid near to its articulation with the sternum and also from the sternum itself.

At present there does not exist material for a detailed comparison of the musculature of the forearm and hand in different groups. The work of Dr. Gadow [16] upon Bird Anatomy contains a good general account of these muscles with their variations in a few types, while Dr. Shufeldt's essay on the Raven [20] and some few papers by other writers deal with these muscles in special forms. Although the object of the present paper is principally systematic, I give an account of the principal muscles of the forearm, since *Rhinocetus* is probably not an accessible type to many of those who are engaged in the study of the muscular anatomy of birds. I have not studied the intrinsic muscles of the hand in my specimen, in the hope that on some future occasion I may have the opportunity of dissecting a recently dead specimen.

When the skin is cut off from the outer side of the forearm, most of the extensor muscles are revealed without further dissection.

(1) *Extensor metacarpi radialis longior*.—This muscle consists of two distinct parts with separate origins but a common insertion: the outer part arises by a thin tendon; this soon expands into a fusiform muscle which is decidedly smaller than the second part of the extensor; the muscle passes into a tendon at a point about half-

way along the radius; soon after this the tendon joins that of the inner head. The inner part of this muscle has a fleshy origin, and it is larger than the outer part of the muscle; its tendon commences nearer to the origin of the muscle than that of the outer head; the combined tendons are inserted on to the metacarpal of digit 1.

Dr. Shufeldt, in his careful account of the myology of the Raven, [20], mentions only a single head to this muscle; and the same thing occurs in other birds.

(2) The *Supinator* is a strong muscle attached up to about the middle of the radius; it is not in any way fused with the *extensor communis digitorum*, as I understand it to be in the Raven from Shufeldt's description.

(3) The *Extensor digitorum communis* arises by a distinct tendon from the humerus in common with the supinator; the muscle passes into its tendon of insertion at about the middle of the forearm; the tendon passes round a smooth surface at the distal end of the ulna in common with that of the flexor metacarpi radialis, and is attached to the proximal end of the *first* phalanx of the index, having previously given off a branch to the thumb.

In the Raven, according to Shufeldt, the insertion is on to the second phalanx of the index.

(4) The *Extensor pollicis longus* arises chiefly from the radius, but also from the septum between itself and the anconæus.

(5) The *Extensor indicis longus* is formed of two parts—one head arising from the lower side of the radius near to its distal end, the other from the carpus.

(6) The *Ectepicondyloulnaris* is a strong muscle, arising by a tendinous origin from the outer condyle of the humerus; it is inserted along rather more than one half of the ulna.

(7) The *Extensor metacarpi ulnaris* arises from the external condyle of the humerus; closely attached to it is a tendinous sheet connected with the tensor patagii brevis tendon; it is inserted by a long tendon to metacarpus, which arises not far from the wrist-joint.

(8, 9) There are two *pronator* muscles, of which the upper is the larger.

(10) *Flexor digitorum sublimis*.—This muscle is visible when the skin is removed; it is related to a strong tendinous sheet connected with the remiges; the muscle itself is largely covered by the flexor carpi ulnaris; its tendon divides into two, the shorter being attached to the wrist, the longer passing down in company with the tendon of the flexor digitorum profundus.

(11) The *Flexor digitorum profundus* arises from a part of ulna just in front of attachment of brachialis internus; it is for a very short space overlapped by this muscle; it also arises from radius; the tendon ends upon proximal end of last joint of the 2nd finger.

(12) The *Flexor carpi ulnaris* is a very large muscle arising by a strong tendon; the distal extremity of the muscle divides into two tendons—one is short and strong and is attached to the ulnare; the other passes down the index digit and is attached to metacarpal III.

(13) *Rector remigium*.—The tendon of this muscle is inserted on to ulnare close to the insertion of the last-mentioned muscle; its fibres are connected with the remiges and also with the sheath of the *flexor carpi ulnaris*.

(14) The *Flexor metacarpi pollicis* arises from the radius; its tendon is inserted in common with that of the flexor sublimis.

II. MUSCLES OF THE HIND LIMB.—(1) The *Gluteus maximus* is enormously developed, reaching to the patella and hiding most of the flexors of the thigh.

(2) The *Semimembranosus* (fig. 3, *Sm.*, p. 17) is inserted by a long and thin flat tendon on to the inner side of the tibia, just below the ligament binding this bone to the femur.

(3) The *Semitendinosus* (fig. 3, *St.*) arises from a part of the ilium which is not occupied by the origin of the biceps; it gives off a large and entirely fleshy *accessory semitendinosus* (fig. 3, *A*); between this latter and the main part of the muscle is a diagonally running tendinous raphe, which is visible only on the inferior aspect of the muscle; just at this point the superior surface of the muscle is connected by a short tendon to the gastrocnemius. The insertion of the semitendinosus is effected by a flat thin tendon which joins the tendon of the semimembranosus about half an inch in front of their common insertion upon the inner side of the tibia. In the Herons (in *Nycticorax*, *Canceroma*) and in *Scopus* the semimembranosus is attached by a separate tendon to the tibia<sup>1</sup>; the semitendinosus is not inserted there at all; in *Psophia* the muscles are inserted by a common tendon, in *Ocydromus* by separate tendons.

(4) The *Biceps* is a broad flat muscle which has the usual form and relations; it passes through a tendinous loop as in nearly all birds before its insertion by a stout tendon on to the fibula.

(5) The *Ambiens*, as Garrod has stated [19], is present.

(6) The *Femorocaudal* is a slender muscle which narrows suddenly into a thin tendon which is nearly one half of the entire length of the muscle. It arises quite in the usual way from the caudal vertebræ and is inserted on to the lower border of the femur.

(7) There is no *accessory femorocaudal*.

(8) The *Gastrocnemius* arises by four separate heads (woodcut, fig. 3):—the outer head is attached to the femur in common with the outer loop of the biceps sling; the second head is smaller and is formed by a short flat tendon attached to the femur; the third head receives a tendon from the semitendinosus and runs up to the femur in close relations with the accessory semitendinosus, it has an attachment also to the inferior of the two adductor muscles; the fourth head is formed by a broad flat tendon to the head of the fibula.

(9) The *Plantaris* is a long muscle with a fleshy origin from the hinder part of tibia just below the internal femoro-tibial ligament; the origin extends as far down as the insertion of the ligament.

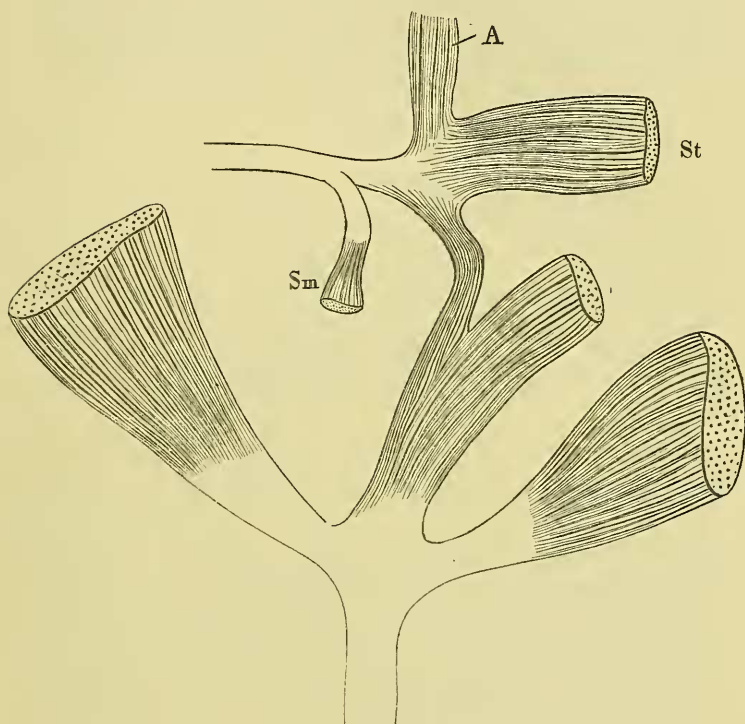
(10) The *Peroneus longus* is a very large and strong muscle, the

<sup>1</sup> Mr. Weldon, however, states that in *Phenicopterus* and the Storks these muscles are inserted in common [21, p. 645].



only one visible on an anterior aspect of the tibia ; it arises from the crest of the tibia, from the fascia covering the tibialis anticus on its upper part, from the septum between itself and the head of the gastrocnemius, and from that between itself and the extensor communis ; its long tendon, as appears to be invariably the case with birds, is attached to that of the flexor perforatus of digit II.

Fig. 3.



Gastrocnemius of *Rhinocetus*, dissected to show its connection with the Semitendinosus.

*St*, Semitendinosus ; *A*, its accessory head ; *Sm*, Semimembranosus.

(11) The *Peroneus brevis* arises from the fibula ; its tendon passes below that of the peroneus longus and is attached to the metatarsals on the outer side. This muscle is wanting in *Ardea* and *Ciconia*, but is present in *Grus*.

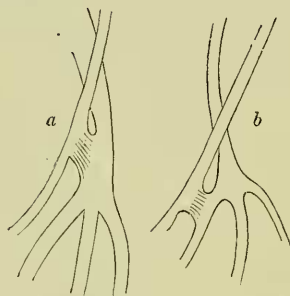
(12) The *Tibialis anticus* lies beneath the *Peroneus longus* ; it arises from two heads—the upper and larger from the crest of the tibia, from the fascia covering the knee, and from the septum between

itself and the neighbouring flexor; its tendon runs at first beside and then above that of the extensor communis and is attached to the metatarsus as usual.

(13) The *Extensor communis digitorum* arises from the crest of the tibia and for about two inches of inner half of outer face of the shaft.

(14) *Flexor hallucis longus*.—This muscle arises from the femur by tendon, and from the fascia covering the flexor superficialis near to its origin. Its tendon is connected with that of the flexor profundus digitorum by a vinculum as in the majority of birds. The arrangement belongs to the first type described by Garrod [19], which characterizes *Gallus* and a large number of other birds; the vin-

Fig. 4.



Connection between tendons of deep Flexors in *Rhinochetus* (a) and *Scopus* (b).

culum is of some breadth, and it is attached to the tendon of the flexor communis before the bifurcation of the latter. I find that my description of this tendon in *Scopus umbretta* does not apply to every individual. I there [14] described<sup>1</sup> a vinculum as being composed of *two* fibrous bands—one attached before the trifurcation of the tendon of the flexor profundus, the other attached to the branch of this tendon supplying the 1vth digit. A dissection of a specimen which died in the Society's Gardens a day or two since shows that in both feet the vinculum is a single structure, which is attached to the branch of the tendon of the flexor profundus supplying digit 1v., and not to the tendon before its trifurcation.

In the strength of the vinculum *Rhinochetus* is unlike most of the Ardeidæ, in which family there is a tendency for it to disappear. I have found this vinculum absent in a specimen of *Nycticorax griseus*; but in this case the vinculum was functionally replaced by a portion of one of the short flexor muscles, which, as in *Rhea* (*cf.*

<sup>1</sup> A MS. note in the handwriting of Mr. Forbes with a sketch shows that my description of the two vincula in *Scopus* was probably correct. It is important to notice the variation.

Gadow, 16, plate xxiii. A. fig. 7), arises from the deep flexors; in *Nycticorax* the muscle was attached to the tendons of both flexors. It would be worth while to inquire into the relations between the muscle and the vinculum, since there are cases of the conversion of muscles into ligaments among birds<sup>1</sup>, among which I may mention the ligament in the Hornbills representing the glutæus maximus of other birds<sup>2</sup>. In *Ardetta exilis* and *A. involucris* there is no vinculum (Forbes, MS.).

(15) The attachment of the flexor tendons to the phalanges varies slightly in different birds.

In the third toe the tendons of the *flexor perforatus* and the *flexor perforans et perforatus* are joined by a short ligament not far in front of the insertion of the first on to the digit; there is no such connection in the case of the same tendons supplying digit II. Digit IV. has of course, like all other birds, no *flexor perforans et perforatus*.

The branches of the *flexor profundus* run to the last phalanx of each digit to which they are attached; but during their course they also give off branches to other phalanges; in the second toe the tendon is attached not only to the last but to the penultimate phalanx. The same additional insertion is present in digits III. and IV., but the IVth digit has a third attachment close to where the tendon perforates the tendon of the *flexor perforatus*; in digits III. and IV. there are several thin branches placed just behind the final insertion of the main tendon.

### *Affinities of Rhinocetus.*

The original describers of this bird, MM. Des Murs and Verreaux [1], placed it definitely with the Ardeidæ; their opinion was based upon the general coloration: the powder-down patches which characterize this bird, and are to a certain extent evidence of its affinity with the Ardeidæ, were not mentioned; the presence of these was first noticed by Mr. Bartlett.

The arrival of a specimen at the Society's Gardens in 1862 enabled Mr. Bartlett to study the habits of *Rhinocetus* [3]; he mentions that its movements are lively and quick, and not slow like those of a Heron; its mode of feeding and its food (snails, earth-worms) differ from those of the Herons; it is compared with *Eurypyga* and regarded as Ardeine.

In 1866 Mr. Bartlett described the egg, which is blotched like that of *Eurypyga* and the Cranes, and quite unlike the Heron's pale green egg with no markings; again, the lively movements are those of a Crane rather than of a Heron.

Prof. Parker, in his 'Monograph upon the Shoulder-girdle,' united

<sup>1</sup> This matter has been gone into by Mr. J. Bland Sutton, F.R.C.S., in his interesting work 'Ligaments, their Nature and Morphology.'

<sup>2</sup> Dr. Gadow, in his work on Birds (Bronn's 'Thierreichs'), has mentioned this ligament in *Bucorvus*. It exists in other Hornbills.

*Rhinochetus* with *Eurypyga* and *Psophia* as a subfamily (*Psophiinae*) of the Cranes. In his paper on the Osteology of the Kagu [7] more stress was laid upon the Ardeine affinities as exhibited in the skull. Prof. Parker's views are summed up in the concluding paragraph, which is as follows:—

“In summing up the affinities of the Kagu, I may say that my view of it is that it is a *generalized* Crane, that it is nearer of kin to *Eurypyga* than to *Psophia*, the latter coming near to the Balearic Crane, whilst *Eurypyga*, like the Kagu, makes a very near approach to the Night Herons amongst the typical Ardeinæ. The Kagu is related to the Rails; but so, indeed, are all the Gruinæ; and Professor Huxley has, with great sagacity, put both these families into one group, and has called the group the Geranomorphæ.”

Garrod [19] discovered that *Rhinochetus* possessed, of the leg-muscles used by him in classification, the ambiens, femorocaudal, semitendinosus, and accessory semitendinosus; its formula therefore is written  $AXY+$ . In his scheme of classification *Rhinochetus* is not mentioned, but it may be inferred that it would have been placed among the Charadriiformes, a group which includes the Cranes, Gulls, and Limicolæ.

Mr. W. A. Forbes [22] associated together *Rhinochetus*, *Mesites*, and *Eurypyga* into a single family of his group Pluviales, which corresponds to the non-columbine Charadriiformes of Garrod.

Dr. Gadow [16], from a study of the intestinal convolutions, was led to believe that *Rhinochetus* should be placed in the near neighbourhood of *Eurypyga* and *Helionis*; it shows “Ralline, Limicoline, and Ibis-like features”; but he finds no affinities with the Herodiones.

Dr. Murie's important paper [8] is illustrated by two plates, in which many of the details of the anatomy of the bird are well shown; it is compared with *Eurypyga* on the one hand and with *Canceroma* on the other; the descriptions show that the affinities are closer to the former than to the latter genus.

Prof. Newton [17] is inclined to compare *Rhinochetus* with the Limicolæ, but to doubt the nearness of its connection with *Eurypyga*; he suggests a suborder “*Grues*,” which might consist of the families Eurypygidae, Rhinochetidae, Gruidae, Psophiidae, and Aramidæ.

Dr. Fürbringer's [15] opinions are presented in a graphic form in the elaborate pedigree diagrams which accompany his work on the classification of birds. He does not accept, any more than does Prof. Newton, Mr. Sclater's group Alectorides [18]. His *Gruiformes*, however, which equals Prof. Newton's *Grues* with the addition of the Cariamidae, only differs from Mr. Sclater's *Alectorides* in not including the Otidae. Among the *Gruiformes*, *Eurypyga* is the type which comes nearest to *Rhinochetus*, but is nevertheless sufficiently different to be placed in a distinct family. Affinities with the Herodii are admitted.

The facts recorded in the present paper do not lend much support to the Ardeine affinities of *Rhinochetus*, though the presence of powder-downs and certain points in the structure of the skull seem

to me, as they have seemed to Fürbringer, to indicate a certain degree of relationship in this direction. The muscular anatomy as a whole is decidedly Crane-like, as will be seen by the following table, which shows some of the resemblances and differences between the Cranes, Herons, and *Rhinochetus*.

	<i>Grus.</i>	<i>Rhinochetus.</i>	<i>Ardeidæ.</i>
Ambiens.	+	+	0
Access. fem.-caud.	+	0	0
Peroneus brevis ..	+	+	0
Biceps slip .....	+	0 <sup>1</sup>	0
Vinculum between flex. hall. and flex. prof.	Strong, attached before trifurca- tion of flex. prof.	Strong, attached before trifurca- tion of flex. prof.	Weak or absent.
Semitendinosus ...	Inserted in com- mon with ten- don of semi- membranosus.	Inserted in com- mon with ten- don of semi- membranosus.	No insertion on to femur.
Tensor patagii brevis.	A tendinous slip running from insertion diag- onally across patagium.	No such ten- dinous slip.	Tendinous slip present.
Expansor secun- darius.....	+	+	Absent in some.

At the same time the absence (?) of a biceps slip to the patagium and the presence of a peculiar additional biceps muscle are peculiarities which mark off *Rhinochetus* from other Crane-like birds.

The syrinx is not specially like that of the Herons; it is perhaps more like that of *Cariama* than other types, but is also like many other Gralline birds. With regard to the special affinities between *Rhinochetus* and *Eurypyga* they are evidently very close; but I propose to defer the consideration of these until I have an opportunity of adding to my notes upon *Eurypyga*.

<sup>1</sup> I could not find the biceps slip in my specimen, but as I have since found a MS. note by Garrod affirming its presence, I have possibly failed to see it.